Management Recommendations for

Leptogium brebissonii Mont.

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SUMMARY

Species: *Leptogium brebissonii* Mont.
Taxonomic Group: Lichens (Rare Oceanic Influenced)
ROD Components: 1, 3
Other Management Status: None

Range: In the range of the Northwest Forest Plan, *L. brebissonii* is known from eight sites in Oregon and one in Washington. The Washington site is on the Olympic Peninsula north of Queets. Six of the eight documented sites in Oregon are on federal lands. It occurs on Eugene District BLM in Heceta Dunes Area of Critical Environmental Concern. Five sites are on the Siuslaw National Forest: Eel Creek Campground, Oregon Dunes National Recreation Area; Sutton Creek Campground, Mapleton Ranger District; a ridge crest above Cedar Creek, Hebo Ranger District; and two sites in the Cascade Head Experimental Forest. Small populations have been found at Carl Washburne Memorial State Park, and the summit of Neahkahnie Mountain.

Specific Habitat: *L. brebissonii* is a strictly coastal species occurring on trees and woody shrubs from sea level to 600 m (2000 ft) elevation, within 16 km (10 mi) of the Pacific Coast. Known habitat conditions for *L. brebissonii* are coniferous and deciduous trees and shrubs in semi-exposed sites such as tree pockets on stabilized dunes, trees on the edge of dune forests, dune woodlands, wetland shrub mosaics, deciduous trees in riparian zones, and open forested stands on ridgetops. Known substrates in the range of the Northwest Forest Plan are Sitka spruce, red alder, rhododendron, evergreen huckleberry, and Hooker's willow.

Threats: The main threats are activities that directly harm the populations, their habitat, or the habitat area surrounding populations. Examples of threats include: burning (in some places); harvesting trees; constructing roads, trails or buildings; recreational activities; grazing; invasive exotic plants; changes in local hydrology; and air pollution.

Management Recommendations:

- Manage known sites to maintain populations and their habitat area.
- Develop practices to route human use away from known sites.
- Manage fire in habitat areas, with emphasis on prevention near occupied substrates.
- Restrict removal of trees, shrubs, or other vegetation from the habitat area, except when removal will not harm habitat integrity.
- Consider opportunities for managing known sites during Forest Plan and Resource Management Plan revisions, such as administratively withdrawn designations, or by prescribing special standards and guidelines.

Information Needs:

- Visit known sites to determine the extent of local populations and improve habitat descriptions.
- Determine if this species is closely associated with late-successional and old-growth forests.
- Determine if additional populations exist in areas identified as potential suitable habitat.

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Management Recommendations for *Leptogium brebissonii*

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Leptogium brebissonii Mont. was described in 1840. It is a lichenized fungus in the family Collemataceae, order Lecanorales, class Ascomycetes (Tehler 1996). Sierk (1964) included some material of *L. brebissonii* in *Leptogium platynum* (Tuck.) Herre, but the latter species grows on soil and rock and does not occur in Washington or Oregon.

B. Species Description

1. Morphology and Chemistry

Leptogium brebissonii (Figure 1) belongs to a group of cyanobacteria-containing lichens known as gelatinous lichens. The cyanobacterial photobiont, *Nostoc*, is scattered throughout the heavily gelatinized thallus rather than in a distinct layer close to the upper surface (Sierk 1964). The medullary area is dark because little or no internal differentiation is present. When wet, *L. brebissonii* can easily be identified by the dark, swollen thallus and the indistinct, ridged lobes with marginal and laminal isidia. When dry, the lichen shrinks to an irregular, tufted, markedly ridged or wrinkled shape. The upper surface is dark green-black when wet, becoming gray-black when dry. The lower surface is similar but paler. Both surfaces lack tomentum. The lobes are partly fenestrate (having small holes). The isidia are fine granular to cylindrical and often arranged in lines along the ridges and lobe margins (Purvis *et al.* 1992, Goward *et al.* 1994b). Apothecia have not been observed in North American material (McCune *et al.* 1997b). This species is anomalous among the species of *Leptogium* found in the coastal Pacific Northwest in having a very thick, gelatinous thallus more reminiscent of *Collema* than of *Leptogium* (Goward *et al.* 1994a).

2. Reproductive Biology

Sexual reproductive structures are unknown for North American material. Instead, *L. brebissonii* reproduces by the production and dispersal of isidia. Isidia are thalloid protrusions less than 1 mm in length, that break off at the base and have the potential to be dispersed long distances by wind or animals. Birds in particular can be important vectors, dispersing lichen propagules along the coastal migratory routes (McCune *et al.* 1997b).

3. Ecological Roles

Because the photobiont of *L. brebissonii* is a cyanobacterium, this lichen is grouped functionally with other epiphytic nitrogen-fixing lichens. Containing up to 4 percent nitrogen dry weight, this group provides especially nutritious forage. Cyanolichens can also make significant contributions of fixed nitrogen to forest soils through leaching and decomposition of the thalli.

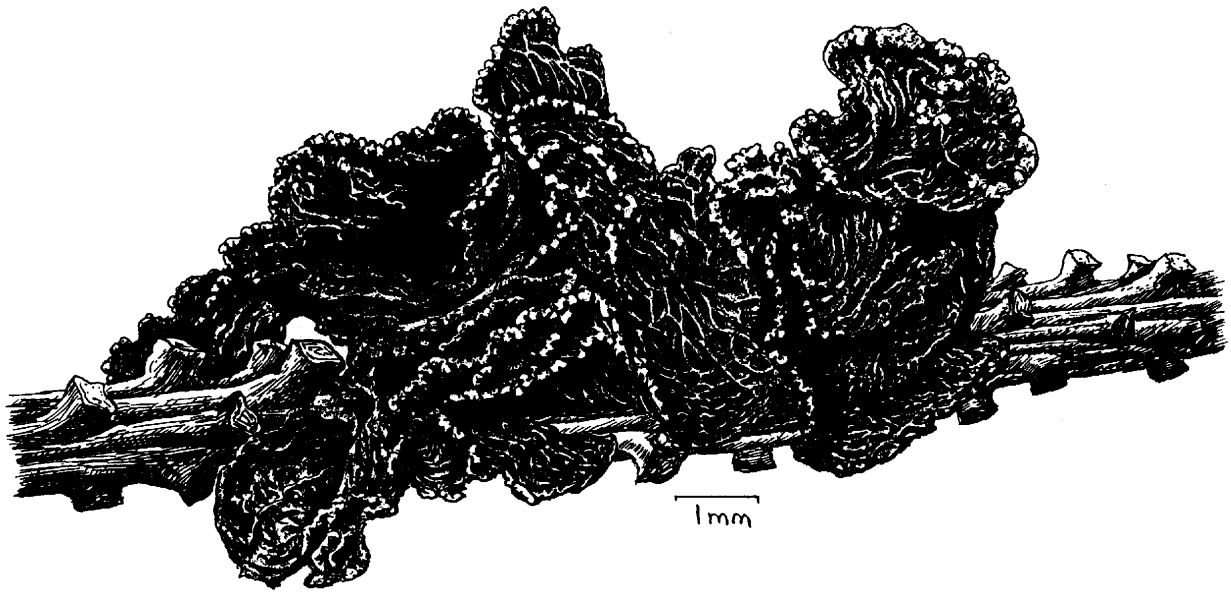

Figure 1. Line drawing of *Leptogium brebissonii* by Alexander Mikulin.

C. Range and Known Sites

Leptogium brebissonii has a broad global distribution; it is known from the western British Islands, western Ireland, western Europe, Macronesia, east Africa, and New Zealand (Purvis *et al.* 1992). The presence of *L. brebissonii* in North America was only recently recognized (Goward *et al.* 1994a). The known North American distribution consists of a single site in southeastern Alaska at Wrangell (Geiser *et al.* 1998), a few sites in coastal British Columbia in the Queen Charlotte Islands, and near Ucelot (Goward 1996), a single site in Washington, and a few scattered sites in Oregon.

In the range of the Northwest Forest Plan, *L. brebissonii* is known from eight sites in Oregon and one on the Olympic Peninsula (Jefferson County north of Queets) in Washington. Six of the eight documented sites in Oregon are on federal land. Five known sites occur on the Siuslaw National Forest: Eel Creek Campground in Oregon Dunes National Recreation Area (NRA) (Coos County); Sutton Creek Campground on the Mapleton Ranger District (Lane County); a ridge crest above Cedar Creek on the Hebo Ranger District (Lincoln County); and two locations in the Cascade Head Experimental Forest (Tillamook County). It occurs at Eugene District BLM Heceta Dunes Area of Critical Environmental Concern (ACEC) (Lane County). Small populations were found in Carl Washburne Memorial State Park (Lane County) and on the summit of Neahkahnie Mountain in Tillamook County (McCune *et al*. 1997b).

D. Habitat Characteristics and Species Abundance

This lichen is typically found in moist, semi-exposed habitats, close to the ocean, on trees or shrubs. Outside North America, it has also been found on mossy rocks. In British Columbia, it is thought to be closely associated with old-growth (Goward 1996). In the range of Northwest Forest Plan, because of sparse distribution and the diverse nature of known habitats, the degree to which it is associated with late-successional and old-growth forests is undetermined.

All known sites of *L. brebissonii* are within 16 km (10 mi) of the coast, from sea-level to 600 m (2000 ft) elevation. Coastal fog may be an important habitat condition. It grows in semi-exposed conditions such as tree pockets on stabilized dunes, wetland shrubs, deciduous trees in riparian zones, and open-grown trees and partially thinned stands on ridgetops. Known substrates in the Pacific Northwest are Sitka spruce (*Picea sitchensis*), red alder (*Alnus rubra*), Pacific rhododendron (*Rhododendron macrophyllum*), huckleberry (*Vaccinium* spp.), and Hooker's willow (*Salix hookeriana*). In British Columbia and southeastern Alaska, *L. brebissonii* has been found on cascara (*Rhamnus purshiana*) and red alder in open, low elevation hypermaritime forests and beach edges (Goward *et al.* 1994b, Geiser *et al.* 1998). In western Europe, it also occurs on mossy rocks (Purvis *et al.* 1992).

At the summit of Neahkahnie Mountain about 1 km (0.6 mi) from the ocean., *L. brebissonii* was found on twigs at the top of a Sitka spruce on an exposed, rocky ridgetop with moss-covered basalt outcrops and pockets of Sitka spruce forest. At Nescowin Creek, it was found on twigs of Sitka spruce in a Sitka spruce/red alder forest. At the mouth of Cliff Creek in Cascade Head Experimental Forest, it was found on the bark of red alder in a young Sitka spruce/western

hemlock (*Tsuga heterophylla*) forest. At the ridge crest above Cedar Creek, also on the Hebo District, it was found in a thinned western hemlock/salmonberry-salal (*Rubus spectabilis-Gaultheria shallon*) forest of young and mature trees. In Carl Washburne Memorial State Park it was found on Sitka spruce at the forest edge. In Sutton Creek Recreation Area, *L. brebissonii* was found at a semi-exposed site on old rhododendron adjacent to the edge of an old Sitka spruce-shore pine (*Pinus contorta*)/evergreen huckleberry (*Vaccinium ovatum*) forest on stabilized dunes, and on evergreen huckleberry. At the Heceta Dunes sites it was found on Hooker's willow near vernal pool lowlands; on a willow branch in a shady thicket of the dune and interdune wetlands with broken Sitka spruce-shore pine/evergreen huckleberry forest and cyanolichen-rich willow and ericaceous shrub thickets; and in willow/sweet gale (*Myrica gale*) wetland thickets and open-grown conifers adjacent to thickets. At Eel Creek, it was found in a shore pine/*Arctostaphylos* woodland.

Physiologically, epiphytic cyanolichens are not considered tolerant of extreme swings in humidity or temperature. They are characteristically found in the wettest microsites: over moss at the bases of trees, or in the canopy on inner, protected branches of trees. Unlike many lichens with a green algal photobiont, cyanolichens must be fully hydrated to photosynthesize (Nash 1996). The availability of moderated microsites is an important factor in the high biomass of cyanolichens in riparian areas and many older forests west of the Cascade crest. Presumably, frequent fog provides favorable moisture conditions for coastal cyanolichens.

II. CURRENT SPECIES SITUATION

A. Why Species is Listed Under Survey and Manage Standard and Guideline

Leptogium brebissonii was thought to be at risk under the Northwest Forest Plan because of its rarity and limited distribution within the range of the northern spotted owl (USDA and USDI 1994a, 1994b). At the time of the lichen viability panel, this species was known from only one site in the range of the northern spotted owl (USDA and USDI 1994a, 1994b). Ratings by the viability panel reflected a high level of concern for this species. The rare oceanic-influenced lichens as a group received the lowest viability ratings among all the lichens considered (USDA and USDI 1994a).

Because of the low viability ratings and high level of concern, this species was identified as a Survey and Manage strategy 1 and 3 species (USDA and USDI 1994c), with the dual objectives of managing known sites and conducting extensive surveys to find additional populations and identify other high-priority sites for species management.

B. Major Habitat and Viability Considerations

Frequent fog, and various ocean-influenced climatic, vegetative and soil factors, appear to be important factors influencing the distribution of *L. brebissonii*. Suitable habitats are sparse and are often separated by many miles. Given the limited availability of habitat, the high rate of human and natural disturbance to these habitats, and the slow colonization rates of *L. brebissonii*

(no large populations have been recorded), it seems likely that this species will continue to be rare within the range of the Northwest Forest Plan.

The major concerns for *L. brebissonii* are the small number of known sites, the limited amount of suitable habitat for this species on federal land, and loss of populations from human activities that directly affect the remaining populations, habitat areas, or potential habitat. Climate changes, especially if they affect coastal fog regimes, and air pollution, are secondary concerns. Degradation or change in habitat conditions could affect the vigor of this species, possibly resulting in an even more restricted distribution or contributing to local extirpation.

Isolation of populations also leads to genetic isolation. Almost nothing is known about the genetics of lichen populations or the effects of gene pool isolation on local extinction rates of populations.

C. Threats to the Species

Threats to *L. brebissonii* are those actions that disrupt stand conditions necessary for its survival. Such actions include treatments that reduce local populations by removing colonized bark or wood substrates; decreasing exposure to light; adversely affecting integrity of habitat areas; reducing or fragmenting potential habitat; or degrading air quality.

Recreational activities and developments may inadvertently alter the habitat of this species. Trampling by recreational vehicles and frequent foot traffic are serious threats, especially in shore pine woodlands and edge communities, as these degrade the habitat by disturbing fragile root systems of trees and shrubs, and the fragile protective mats of ground cryptogams, which stabilize the soil (Christy *et al.* 1998). Destabilization of the foredunes by recreationists or removal of European beachgrass (*Ammophila arenaria*) can destabilize tree island habitats of *L. brebissonii* by increasing the amount of sand drift into them and burying trees on the perimeter (Christy *et al.* 1998). Buildings, roads, campgrounds and trails along the immediate coast have replaced many natural habitats to improve access, facilitate scenic views, or develop recreational uses.

Other threats to the integrity of habitat and potential habitat areas include logging, grazing, agriculture, and activities which alter local hydrology, or increase fire frequency (Christy *et al.* 1998). Concern about fire varies--many different plant communities and successional stages exist among the coastal dunes and headlands; fire is beneficial to some communities but damaging to others. Invasion or planting of exotics such as Scots broom (*Cytisus scoparium*), European beachgrass, tree lupine (*Lupinus arboreus*), birdsfoot-trefoil (*Lotus corniculatus*), and iceplant (*Mesembryanthemum* spp.) can have profound effects on nitrogen-poor dune soils by increasing nitrogen and soil moisture. These conditions foster invasion of other weeds, eventually disrupting native plant communities (Christy *et al.* 1998) and reducing plant and animal diversity (USDI 1997).

Like other epiphytic cyanolichens, members of the genus *Leptogium* are considered very sensitive to air pollution (Wetmore 1983, Insarova *et al.* 1992, McCune and Geiser 1997).

Although air quality is relatively good at known sites, increased pollution emissions from increased traffic and new or expanded industry along the coast may threaten this species. Pollutants of most concern are SO_2, NO_x, and acid deposition containing sulfur and nitrogen compounds.

Climate change affecting coastal fog patterns could be expected to affect the vigor of this species, possibly resulting in an even more restricted distribution or contributing to local extirpation.

D. Distribution Relative to Land Allocations

Leptogium brebissonii is known from six sites on federal land. The two sites in Cascade Head Experimental Forest and the population at Eel Creek Campground in the Oregon Dunes National Recreational Area are Congressionally withdrawn for research and recreational emphases, respectively. Sutton Creek Campground on the Mapleton Ranger District is administratively withdrawn as a recreation area. The site at Cedar Creek on the Hebo Ranger District is in a late-successional reserve. The Eugene District BLM Heceta Dunes ACEC is administratively withdrawn.

III. Management Goal and Objectives

A. Management Goal for the Species

The goal for managing *L. brebissonii* is to assist in maintaining species viability.

B. Objectives

Manage populations at all known sites by maintaining habitat and suitable habitat immediately surrounding known populations.

IV. Habitat Management

A. Lessons From History

Habitat destruction or alteration has made a significant contribution to the decline of lichens world-wide (Seaward 1977). Rare lichens that are limited to habitats optimal for human activities, such as *Leptogium brebissonii*, are especially vulnerable. In coastal Oregon, activities of the past 140 years: increased fire, agriculture, and grazing, logging, changes in hydrology and recreation have affected plant succession in a major way (Christy *et al.*, 1998). At Sand Lake dunes of Oregon, a hotspot for lichen diversity, off-road vehicles have destroyed nearly all the shore pine woodlands in just thirty years (Wiedemann 1984, 1990 as cited by Christy *et al.* 1998). At the northern Samoa Peninsula, the native dune communities have been nearly

eliminated by the invasion of European beachgrass and human activities, and only a tiny fragment of the dune forest remains (Glavich, pers. comm.). At the Lanphere Dunes Unit, even hiking has been documented to damage fragile shore pine/bearberry (*Arctostaphylos uva-ursi*) communities (Brown 1990).

Lichens have been known to be sensitive to air pollution for more than a century. Many species in Europe (Ferry *et al.* 1973, Hawksworth and Rose 1976) and the eastern United States (Brodo 1966, Showman and Long 1992, McCune *et al.* 1997a) are in an active state of decline from sulfur dioxide, nitrogen oxides, and acidic deposition of sulfur- and nitrogen-containing pollutants. Fog contains more dissolved ions and acidity than precipitation does (Wolseley and James 1992). Lichens that obtain most of their water from fog and dew are particularly vulnerable to air quality and weather pattern changes (Nash 1996). Follmann (1995) documented massive impoverishment and retrogression of lichens over much of the northern Chilean coastal fog belt over the past 20 years. Increasing frequency of El Niño events and gradually increasing aridity were postulated as likely, but not exclusively, causal factors in this decline. In the Pacific Northwest, sensitive species are already declining in some areas (Denison and Carpenter 1973, Taylor and Bell 1983) and lichens have been identified as Air Quality Related Values in USDA Forest Service regional air resource management guidelines (Peterson *et al.* 1992).

B. Identifying Habitat Areas for Management

All known sites of *L. brebissonii* on federal lands administered by the Forest Service and BLM in the range of the Northwest Forest Plan are identified as habitat areas where these management recommendations should be implemented. A habitat area for management is defined as suitable habitat occupied by or near a known population.

C. Management Within Habitat Areas

The objective of managing in habitat areas is to maintain the habitat conditions for *L. brebissonii*. Sites with known populations should be managed to include an area large enough to maintain the habitat and associated microclimate of the population.

- Determine the extent of the local population and habitat area with a site visit.
- Maintain suitable habitat around the current host trees and shrubs, so that the lichen may have adequate new substrate as current substrates decline.
- Develop practices to route human use away from the populations in habitat areas (for example, divert roads, trails and off-road vehicles). Trampling shrubs or cryptogam mats, compacting roots, damaging trees or branches that serve as substrates, introducing non-native species by seed dispersal or planting, can all adversely affect habitat integrity.
- Avoid harvesting trees, shrubs, or other vegetation from the population and habitat area unless these actions would do no harm to, or would improve, the habitat for *L. brebissonii* (for example, to prevent deeply shaded conditions or remove invasive exotics).
- Restrict commercial collection of moss or fungi or other special forest products if these activities would adversely affect the integrity of habitat areas.

- Prevent fire in the population but utilize or prevent fire in habitat areas, depending on the role of fire in the plant community. Consider recommendations by Christy *et al.* (1998) for fire management and prescribed fire in coastal plant communities.
- Maintain integrity of the foredunes or other coastal features where they protect habitat areas.

D. Other Management Issues and Considerations

- Consider opportunities for managing known sites during Forest Plan and Resource Management Plan revisions, such as Botanical Special Interest Areas, Areas of Critical Environmental Concern, or other administratively withdrawn designations, or by prescribing special standards and guidelines.
- Share information with state and private sectors to further activities directed at conserving *L. brebissonii.*
- Continue to work with state and federal regulatory agencies to protect air quality on federally-managed lands from on- or off-site emissions, especially of nitrogen- and sulfur-containing pollutants.
- Provide information about conserving rare lichens at visitor centers or other locations along the coast to build public support of conservation efforts and to discourage collection of specimens.

V. RESEARCH, INVENTORY, AND MONITORING NEEDS

The objective of this section is to identify opportunities to acquire additional information which could contribute to more effective species management. The content of this section has not been prioritized or reviewed as to how important the particular items are for species management. The inventory, research, and monitoring identified below are not required. These recommendations should be addressed by a regional coordinating body.

A. Data Gaps and Information Needs

- Visit known sites to determine the extent of local populations, describe their habitat, and to clarify the association of this species with late-successional or old-growth forests.
- Determine if *L. brebissonii* meets the criteria for being closely associated with late-successional or old-growth forests.
- Determine whether additional populations exist in areas identified as potential suitable habitat. Known habitat conditions for *L. brebissonii* are coniferous and deciduous trees and shrubs in semi-exposed conditions such as tree pockets on stabilized dunes, trees on the edge of dune forests, dune woodlands, wetland shrub mosaics, deciduous trees in riparian zones, and open forested stands on ridgetops from sea level to 600 m (2000 ft) elevation, and within 16 km (10 mi) of the ocean.
- Assign priority to Strategy 3 surveys in areas where management treatments or projects are scheduled or proposed.

B. Research Questions

- What are the dispersal and growth rates of *L. brebissonii*?
- Which habitat characteristics are necessary for colonization by *L. brebissonii*? Are conditions unique to late-successional and old-growth forests critical to the survival of this species?
- Can stands be managed to mimic those characteristics?
- What are the minimum and optimum patch sizes of colonized habitat necessary to provide for *L. brebissonii*?

C. Monitoring Needs and Recommendations

- Monitor dispersal and population trends of existing populations.
- Monitor known sites for changes in microclimatic conditions, successional changes, and for inadvertent habitat damage from human activities or wildfire.
- Monitor air quality near key populations of *L. brebissonii* on federal lands and assess threats to this species from present or projected air-quality trends.

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